EXPERIMENT 13: POTENTIAL ENERGY to KINETIC ENERGY

PURPOSE:
Understanding the relationship between potential energy and kinetic energy.

MATERIALS:
inclined plane or ramp (for example sargent welch WLS1826-71), measuring tape in cm, 2 Steel spheres of different size, Stop watch, 3 meter sticks, measuring tape, masking tape, jack or blocks

DATE______________

AUTHOR ____

PARTNER ____

PARTNER _______________________________________

BACKGROUND

In Physics, the unit for energy is joule. mass is in kilograms, height in meters and the acceleration due to gravity is g=9.8m/s/s or 980cm/s/s on Earth (or 22mph/s) Because we are going to deal with small amount of energy and also, for convenience, we are going to use a different unit called **erg**. In this lab:

energy is in **ergs**, distances are in **cm,** masses are in **grams** and **g=980cm/s/s/**

Potential energy is stored energy.
Kinetic energy is the energy of moving objects.

Gravitational potential energy is the stored energy that an object has because of its position. The amount of gravitational energy that an object has is shown by the following formula :

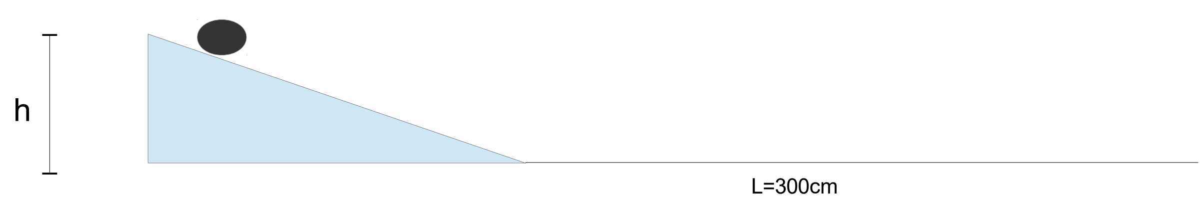
potential energy (in ergs)**= mass** (in grams) **x g x height** (in cm)
Or PE = m g h **g = 980 cm/s/s**

If a sphere of mass m is rolling down a ramp (not sliding) at a speed v (cm/s) then its energy of motion (kinetic energy) is given by the formula:
kinetic energy = 0.7 x mass x (speed of sphere)^2
Or **KE = 0.7 m** v^2

Note: if a body slides instead of rolling then the kinetic energy is less KE = 0.5 m V^2.
A rolling sphere has more kinetic energy and KE = 0.7 m V^2

When an object falls to the ground or rolls down a ramp, its gravitational energy is converted into kinetic energy. In this challenge, you will compare the amount of potential energy that an object has at the top of a ramp with the kinetic energy that the object has at the bottom of the ramp and it rolls on the floor.

PROCEDURE : Get 2 spheres of different mass.



1. Place an inclined plane on the floor. Use a jack (or blocks) to incline the plane as high as possible. Use 3 meter sticks to show the distance the sphere will cover on the floor (3 meters or 300cm) from the bottom of the incline. This distance will be called L. You can use the wall to stop the sphere after it covers the 3m.

L (cm) = _________ (300cm if you used 3 meter sticks)

2. Mark a position on the inclined plane with a pencil or chalk. The sphere will always be placed at the same position for each run. Place the metal sphere on the plane and measure (with a measuring tape) its height relative to the ground (from the bottom of the sphere to the floor). This is h .

h =_________ cm (!! not inches!!)

3. Let the largest sphere roll down the incline.

4. Using a stopwatch, measure the time t the sphere takes to roll the marked distance L **on the floor after rolling down the incline. So you are measuring only the time for the sphere to cover the distance L.**

5. Repeat this measurement for a total of 10 trials and record your results in the table below.
6. Repeat the same procedure for the small sphere.

TABLE 1:

Trial	**sphere1** Time (s)	**spere1** speed V (cm/s) sphere 1	**sphere 2** Time (s)	**sphere 2** Speed V (cm/s) sphere 2
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				

5. For the sphere 1 compute its speed for each trial. Speed is **length / time elapsed**. With length = 300cm. Repeat for sphere 2.
6. For your sphere 1, check your speed. If you see one (or more) that is significantly larger or smaller than the others, cross the trial out (eliminate the data) . So your average don't get messed up. Repeat for sphere 2.

7. Compute the average experimental speed of the sphere1: Average speed sphere 1 = ___________ cm/s

8. Repeat all the steps for sphere 2 (smaller).
Average speed sphere 2 = ___________ cm/s

9. You are going to compare the energy of the sphere at the top of the plane (solely gravitational potential) to the energy at the bottom (solely kinetic). According to the law of conservation of energy:

$$\textbf{energy at the top (PE = mgh) = energy at the bottom (KE = 0.83 mv}^2\textbf{)}$$

(This is true only if we neglect the energy lost to friction)

So we have **mass x 980 x height = 0.7 x mass x (average speed)^2**

We can cross out the mass and the conservation law becomes :

980 x height = 0.7 x (average speed)^2

gravitational energy per unit mass = kinetic energy per unit mass if we neglect friction

So the mass of the sphere does not matter when comparing KE and PE. That's because when an object is in free fall (or diluted free fall on a ramp), the mass does not matter. We neglect friction between the sphere and the plane or the ground.

10. Use the height of the ramp and the acceleration due to gravity (980cm/s/s) to calculate

980 x h for each sphere. (h is the height of the sphere above the ground in cm). record in TABLE 2

11. Use the average the speed V of the spheres to compute **0.7 V^2**. record in TABLE 2

TABLE 2:

sphere	**Height (cm)**	**980 x height** **PE per kg** **unit is ergs/kg**	**0.7 x (average speed)^2** **KE per kg** **unit is ergs/kg**
1			
2			

IF WE NEGLECT FRICTION ALL THE NUMBERS SHOULD BE the SAME. BECAUSE of friction, the PE should be slightly larger than the KE. Also it depends how precise where your measurements. The uncertainty on the time measurement and on the distance measurement will pollute the final computations.

ANALYSIS:

1) In theory, if we neglect the **friction** between the mass and the plane, the PE at the top of the plane = KE at the bottom of it. The potential energy is transformed into energy of motion. Was it the case ? Discuss .

2) The potential energy is proportional to the _______ , ___________ and ____________

The kinetic energy is proportional to the _________ and the _________ ___________.

3) If we neglect friction, why should you find KE=PE (see above) for both spheres?

4) Energy cannot be created or destroyed. What happens to the energy that the object seems to " lose " as it rolls down the tamp ?

CONCLUSION